NASA

SLI
SPACE LAUNCH INITIATIVE



Space Launch Initiative

New Capabilities ... New Horizons

Daniel Dumbacher
Deputy Program Manager

10th Japan – US Conference on Composites Materials, September 2002
Stanford University

Topical Outline

NASA

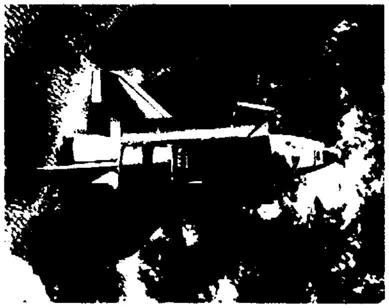
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SPACE LAUNCH INITIATIVE



- Integrated Space Transportation Plan
- SLI: The Work of a Nation
- SLI Goals & Status
- Composites & Materials
- SLI & DoD/USAF Collaboration
- Summary

Integrated Space Transportation Plan: A National Plan

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Space Shuttle Safety Upgrades



Space Launch Initiative



3rd Generation and
In-Space Research
and Technology

NASA's Long-Term Investment Strategy to Increase the Safety, Reliability and Reduce the Cost of Space Access

Team SLI



Team SLI Formed — A Nationwide Partnership

- Synergy Between Government & Industry
- Empowering the Right Work in the Right Hands
  - Growth of Intellectual Capital
  - Developing a National Team
  - Knowledge-Driven Process Management

Pursuing Dramatic Improvements in America's Space Capabilities

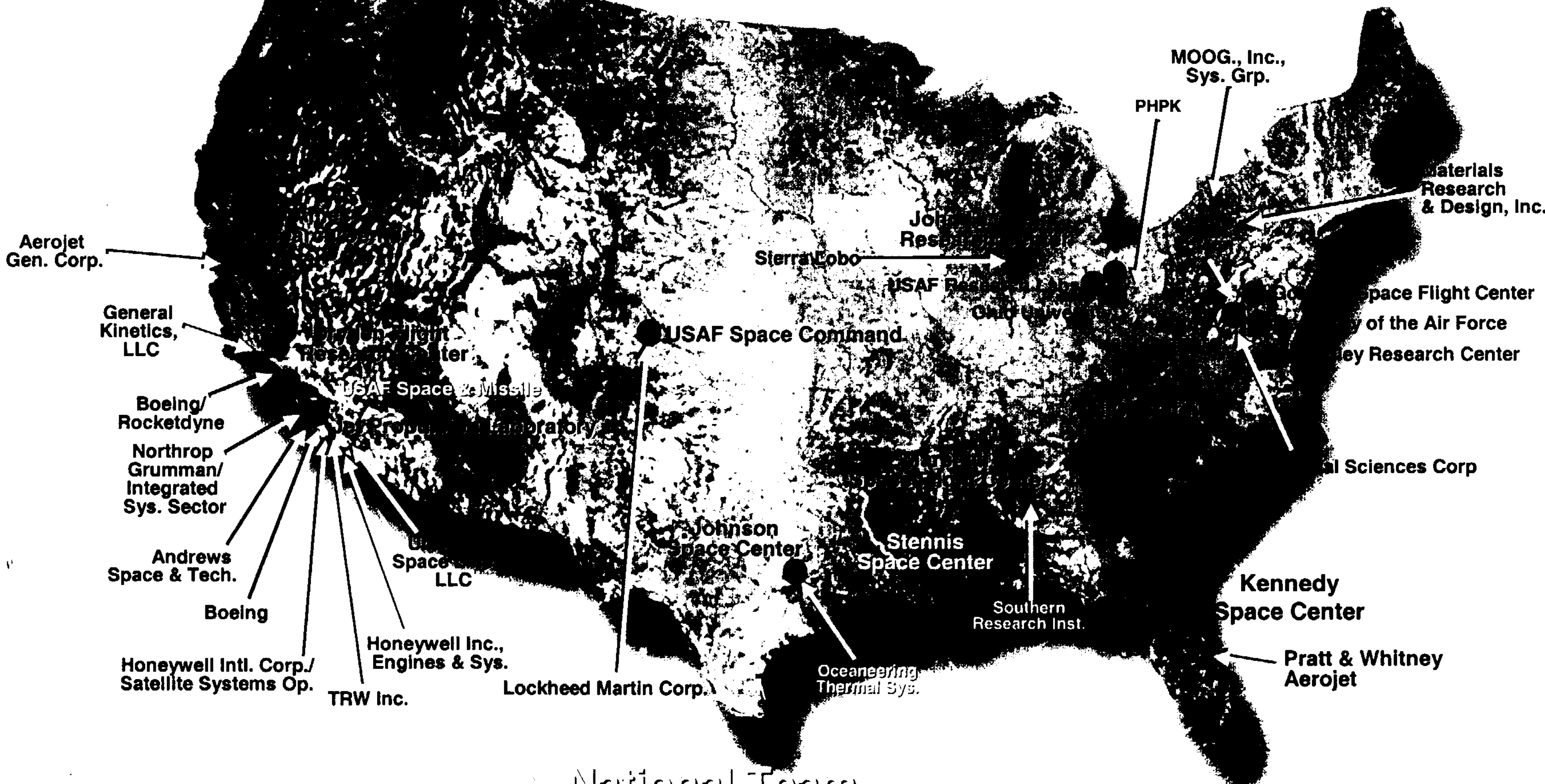


- **Goals:**
  - Improve Safety with a Goal of 1 in 10,000 Loss of Crew
  - Reduce NASA's Mission Price
- **Objectives:**
  - Converge Requirements for NASA, DOD, and U.S. Commercial Missions
  - Design A Complete Space Transportation Architecture
  - Develop Critical Advanced Capabilities to Build & Operate the New System
  - Competitive Business Environment for Industry

The Work of a Nation: A New Era of Collaboration

NASA | SLI Space Launch Initiative

Currently 22 Primes and 158 Subcontractors



NASA Centers
U.S. Air Force Centers
Universities
Prime Contractors

- National Team
  - Civil
  - Commercial
  - Academic
  - Defense
- Empowering America's Leadership in Space through Technological & Business Innovations

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Program Goal Status

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- 70% of Life Cycle Cost Driven by Design
  - Requirements Simplification
  - Design Solutions to Address Operations and Safety (Requires Understanding of Root Causes)
  - Flow-down of Key Requirements to Technology Projects
- Separate Crew and Cargo (Converges With Projected Large GEO Satellites)
- Higher Mach Staging (Results in Powered Fly-back)
- RP 1st Stage Propellant
  - Smaller 2nd Stage - Drives TPS Operations Savings, Potential for Expander Engine
  - Shifts Emphasis From Composite to Metallic Cryo-Tanks
- Crew Escape System Required to Meet Safety Goals

A Year of Technical & Business Success

SPACE LAUNCH INITIATIVE



Crew Escape & Survival



Operable, Long-Life Engines



Long-Life, Lightweight Integrated Airframe

Critical Technology Areas for Next Generation RLVs

Designs and Technology Focused on Maximizing Return on Investment

Requirements, Design, Hardware Test, & Proven Business Models

Matching Technology to Competing Designs

Demonstrating Technical Breakthroughs

Investment Alignment

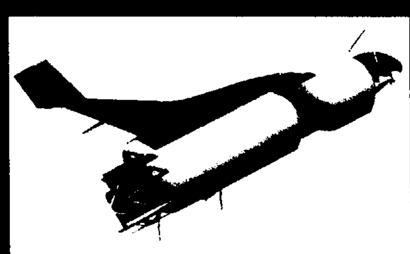


Crew Escape & Survival





Operable, Long-Life Engines



Long-Life, Lightweight Integrated Airframe

Critical Technology Areas

Technology Focused on High-Value Investments

- Matching Technology to Competing Designs
- Government Controls Data Rights
- Maximizing Return on Investment:
  - Requirements, Design, Hardware Test, & Proven Business Models

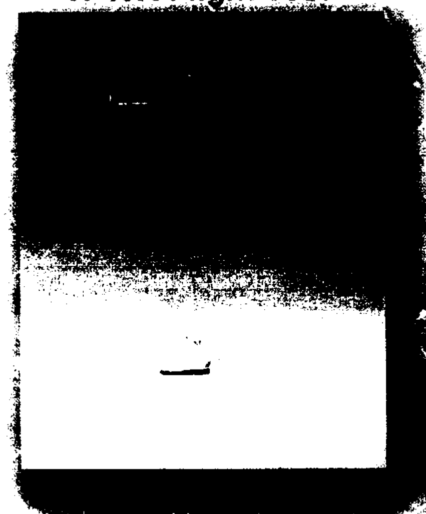
A Year of Technical & Business Success

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SLI SPACE LAUNCH INITIATIVE

Technology Research Focused on High-Value Investments: Flight Demonstrations

X-40A Flight Test



X-37 Flight Demonstrator



X-40A Assembly/Checkout



- X-37 Flight Demonstrator:
  - Crew Carrier Prototype Test Vehicle
  - 7 Successful Flights of Scale-model Vehicle (X-40A)
  - X-37 Wings Manufacturing and Test Completed
  - 6% Scale Model Wind Tunnel Test Completed
  - 80% of X-37 Acreage Areas Can Be Used to Test Advanced Thermal Protection Materials

Integrating Advanced Technologies for Testing in Real-world Flight Environments

Advanced Engineering Environment

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Data + People + Tools

→ Integrated Analysis Solutions

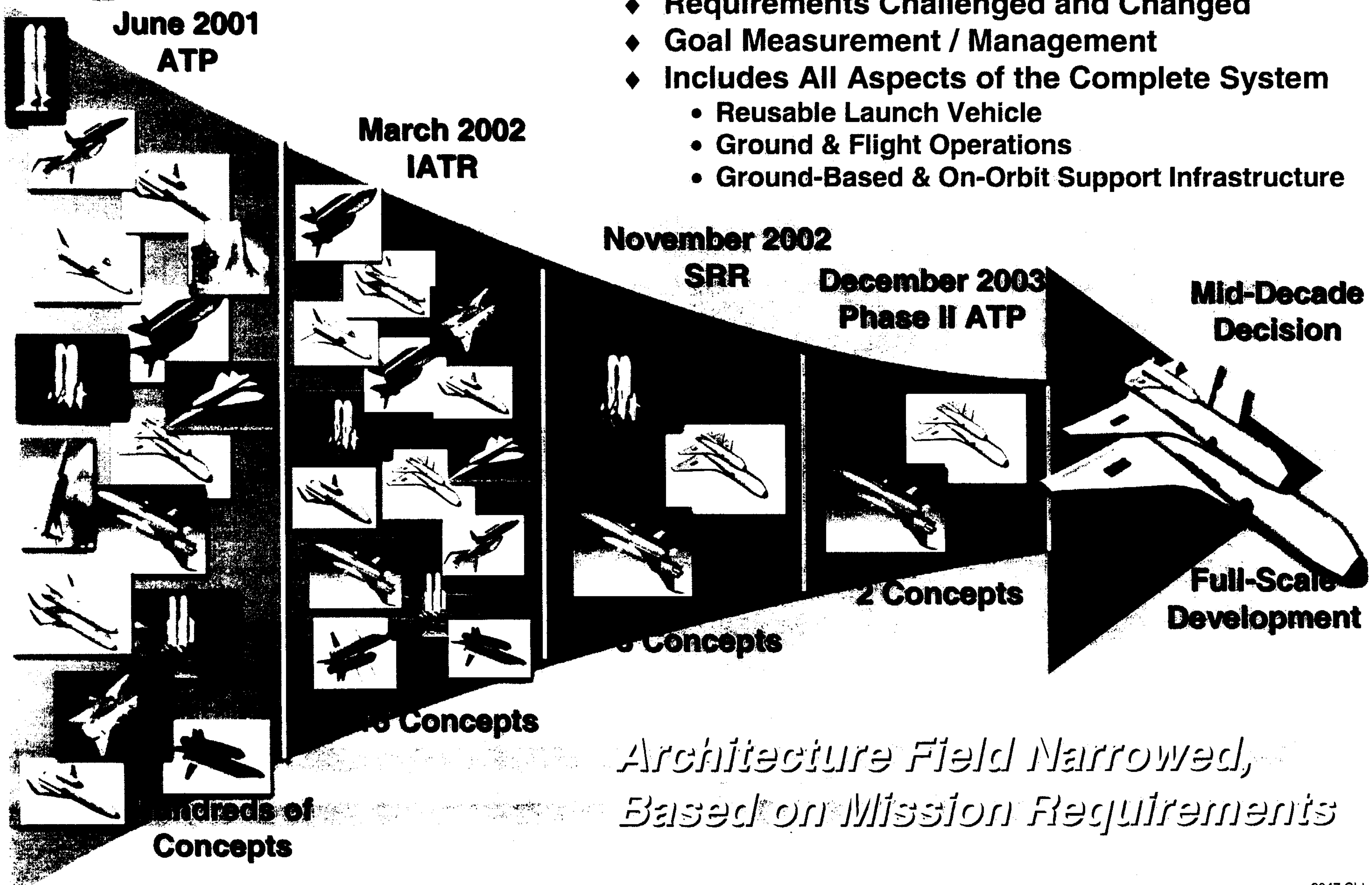
→ Informed Decisions

- A SINGLE Integrated Engineering Environment:
  - Mission Performance Analysis
  - Life-Cycle Analysis
  - Data Configuration Management
  - Design Decision Making
  - Access to the Right Expert at the Right Time With the Right Data
  - Elimination of Non-Value-Added Activities (e.g., Data Manipulation/Input)
- NASA-wide Resource Independent of Analysis Expert's Location
- Complementary with Proposed Agency AEE Initiative

Architecture

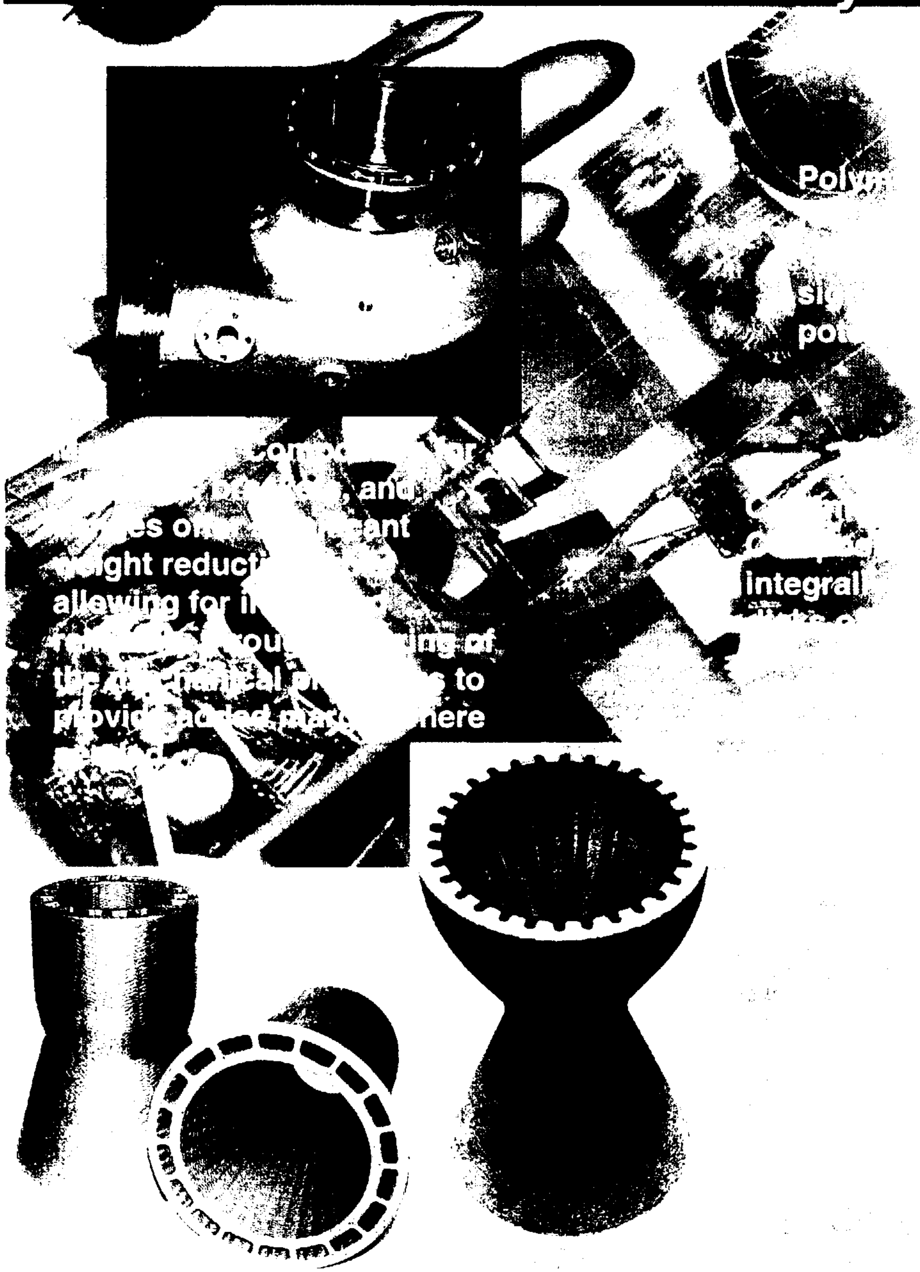
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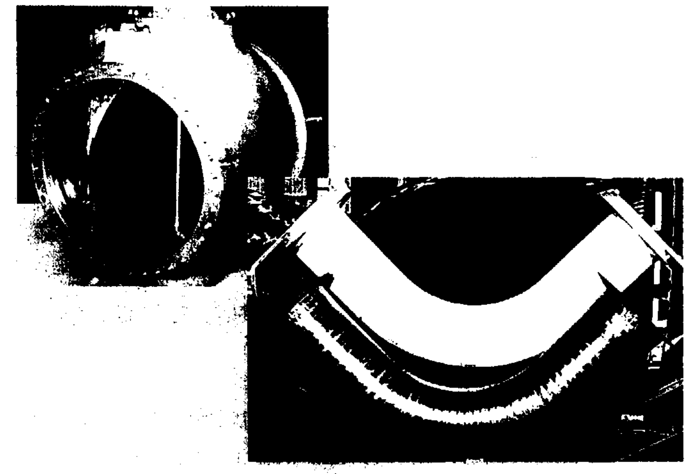
- ♦ Requirements Challenged and Changed
- ♦ Goal Measurement / Management
- ♦ Includes All Aspects of the Complete System
  - Reusable Launch Vehicle
  - Ground & Flight Operations
  - Ground-Based & On-Orbit Support Infrastructure

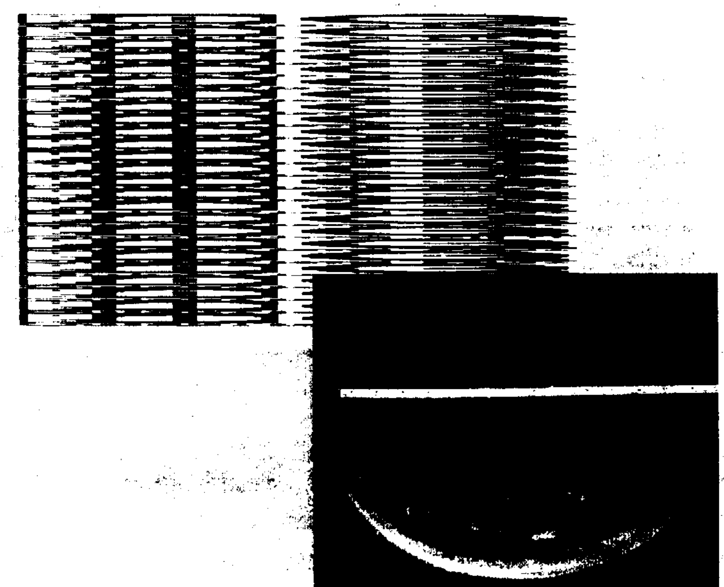


Architecture Field Narrowed, Based on Mission Requirements

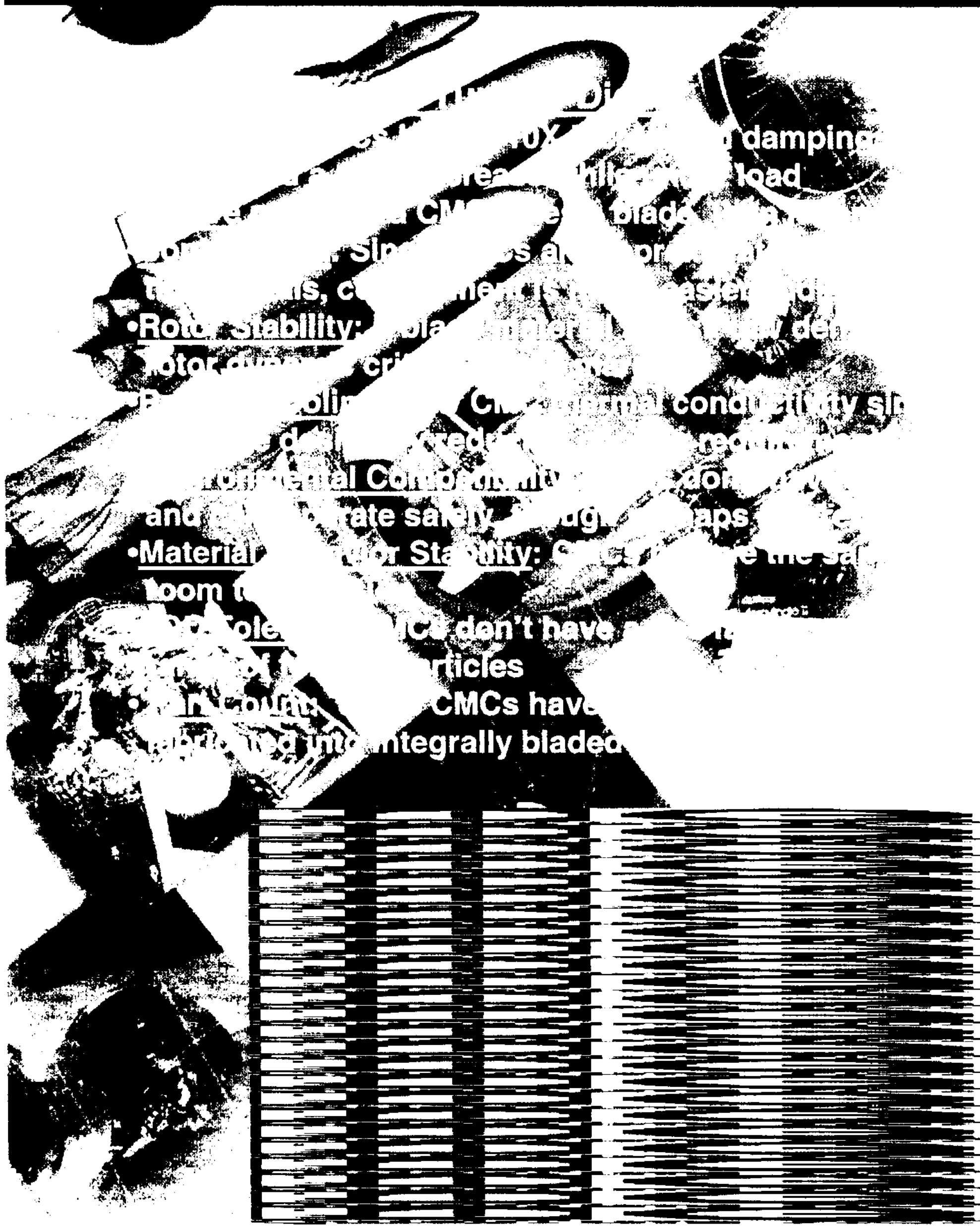
Composite Materials for Future Propulsion Systems



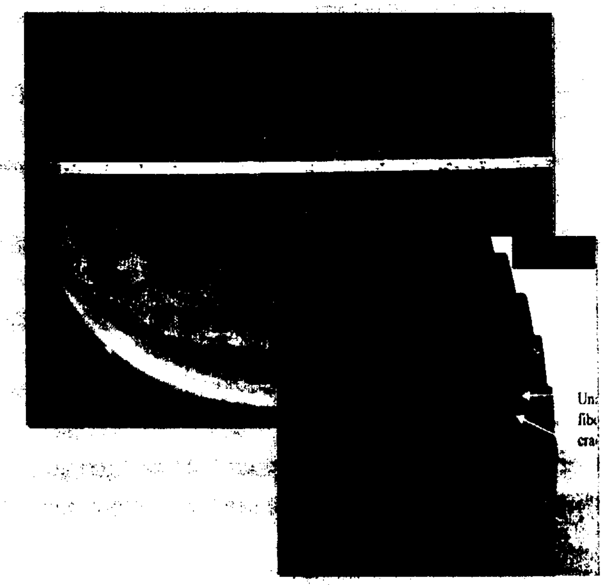




Ceramic Matrix Composites (CMCs) in Propulsion



damping
load
blade
•Rotor Stability:
conductivity
•Material Stability:
CMCs don't have
articles
CMCs have
integrally bladed



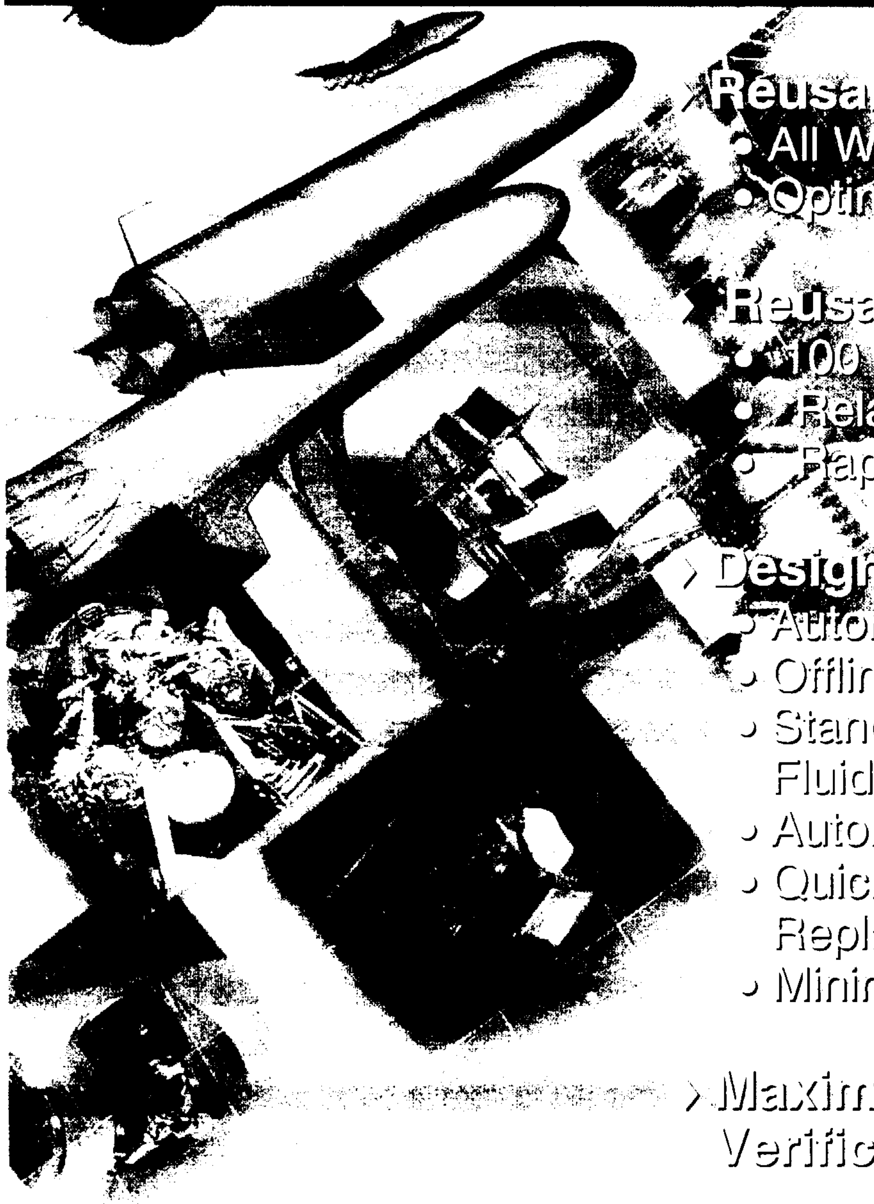
SLI – US Air Force Collaboration

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- Significant Leverage Exists to Advance a National RLV Agenda
- National Investment Best Focused on One Major RLV Architecture Development
- Documented Need for New RLV System
  - Transformational Warfighting Capability
  - Shuttle Replacement for NASA
  - Commercial Launch Leadership

NASA / USAF RLV Synergy

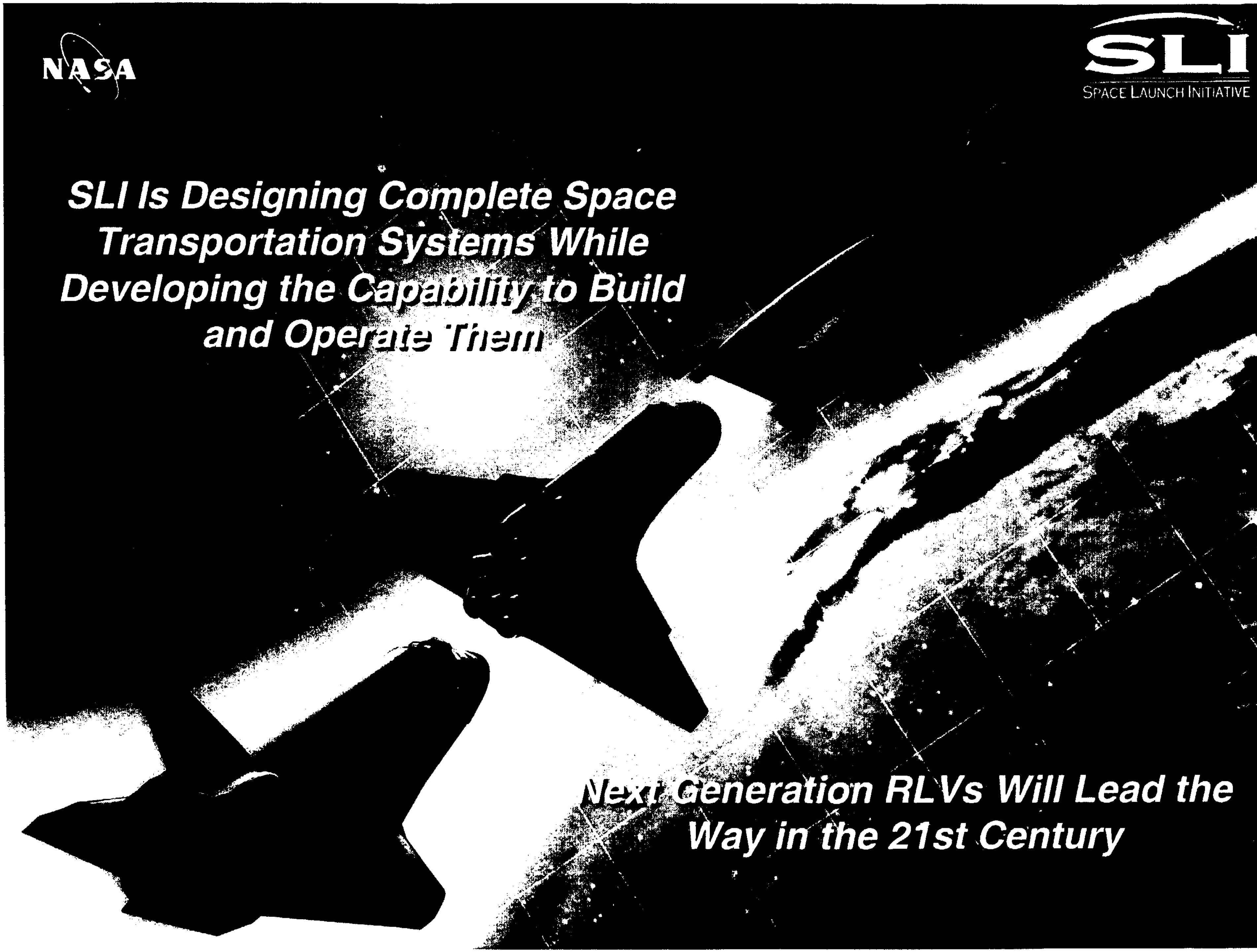


- Reusable / Operable Airframe and TPS
  - All Weather Damage Tolerant / Resistant
  - Optimize and Automate Inspections
- Reusable Engines (particularly LOX/RP)
  - 100 mission flight life
  - Relaxed Drying Requirements
  - Rapid Chilldown and Large Start Box
- Design for Operations
  - Automated Umbilical Connections and Checkout
  - Offline Payload Processing and Encapsulation
  - Standard Payload Interfaces (Structural, Electrical, Fluid, Data)
  - Automated Payload Alignment and Attachment
  - Quick Access to Components for Rapid Removal & Replacement
  - Minimize Subsystem Servicing Between Flights
- Maximum Use of IVHM System for Subsystem Verification



SLI is:

- One NASA Team
- Creating Capability to Design New Transportation Systems
- Advancing New Technology and Engineering Systems
- Implementing Disciplined Management Systems
- A Flexible and Accountable Organization that Delivers as Promised
- Different


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SLI Is Designing Complete Space Transportation Systems While Developing the Capability to Build and Operate Them
Next Generation RLVs Will Lead the Way in the 21st Century